# Space Weather Technical Forecast

Issued on Wednesday, 18 September 2024 at 13:32 Local

**Following the arrival of the CME late on 16 Sep, high energy electron flux levels were suppressed to background. A recovery is currently underway with fluctuations between moderate and background and an overall rising rend. Flux levels at GEO are displaying apparent suppression, although a rebound is anticipated later in the coming UTC week. The recovery in flux levels and charging associated with the CME arrival is expected to see the diurnal pattern return to moderate with peaks at high during diurnal maximum.**
**The anticipated onset of a narrow stream of fast winds from CH70/+ later Day 1 or 2 (18-19 Sep) is not expected to influence the forecast greatly, but there is a slight chance that it may act to further suppress and delay the electron flux recovery. This lowers confidence in the forecast values for Days 3-4 (20-21 Sep).**
**The forecast is therefore uncertain, but should continue to exhibit a suppression and then rise to an elevated level. The associated fluence is anticipated to rise uncertainly towards the Active threshold. MOSWOC REFM is not considered to be useful guidance given the dominance of recent CME influences.**
**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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**Space Weather Forecast Headline: CME influences waning Day 1 (18 Sep). Ongoing Chance of M-class flares.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity**: Activity measured at GOES16 and 18 was Low with only C-class flares observed in the past 24 hours, with the largest a C4.1 observed at 18/0344UTC from AR3828 in the southeast quadrant. Slight Chance of X-class flares, mainly from AR3825, and to a lesser extent AR3824.

There are approximately seven sunspot regions on the visible disc, two of which are unnumbered. AR3814 has rotated off the disc and AR3822 faded to plage over the pat 24 hours. AR3825, in the southeast, remains the largest and most complex region on the disc. This region consists of a large trailing spot, a weak intermediate portion, and a compact an complex lead portion. This lead portion contains a marginal delta configuration that has weakened over the past 24 hours. This region remains perhaps the most noteworthy group due to its history of X-class activity. AR3824, in the southwest, has seen some consolidation of its leading spot but remains a magnetically complex Beta-Gamma region. A number of small spots have developed from plage or split from the large of AR3828, in the southeast. This has led to the region being reclassified as Chi/Beta. The remaining regions are relatively small and stable.

No Earth-directed Coronal Mass Ejections (CMEs) were observed on available coronagraph imagery during the period.

**Solar Wind / Geomagnetic Activity:** Solar wind parameters, as observed by ACE at L1, displayed the waning effects of the CME, which arrived late on the 16 Sep. Solar wind speeds started the period around 520 km/s and have been on a generally gradually declining trend with speeds of 400-450 km/s between 18/000-0800 UTC. In recent hours the winds have fluctuated between slightly elevated and elevated levels and at time of issue are around 430 km/s. The phi angle was positive (away from the Sun) for the majority of the period, with only brief spells of

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slightly negative (towards the Sun) phi observed. The solar wind density was average initially, soon falling to to below average levels where it remains. The IMF was moderate with peak of 13nT at 17/1237UTC having declined from strong levels before the start of the period. The north-south component, Bz, was predominately negative (southward) until 18/0140 UTC following the CME arrival, varying between +8 and -10nT. Between 18/0140-0840 UTC the Bz was weakly positive (northward), since then the winds have weakly fluctuated but tended towards negative.

Geomagnetic activity was initially at G1/Minor Geomagnetic Storm (Kp 5) levels before easing Unsettled (Kp3) to Active (Kp4). Since 18/0300 UTC, activity has been Quiet (Kp 1-2).

**Energetic Particles / Solar Radiation:** High energy (greater than 10 MeV) proton flux observed by GOES18 was at S1/Minor Solar Radiation Storm levels initially, peaking at 25pfu around 17/1200 UTC. Levels fell below the S1 threshold around 17/1615UTC and are now close to background levels.

High energy electron flux (greater than 2MeV) observed by GOES16, generally varied on a diurnal cycle between Normal Background to Moderate levels, but are on a gradual rising trend. The associated 24-hour fluence declined steeply at the start of the period, but has increased slightly since 18/0600 UTC.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Low to Moderate activity is forecast, with an ongoing Chance of M-class flares, most likely from AR3824 or AR3825. There is a continued Slight Chance of an isolated X-class flare, most probably from AR3825. No significant regions are expected to arrive in the period, although AR3824 will cross the western limb late Day 3 and during Day 4 (20-21 Sep). The flare risk is deemed largely constant as a result.

**Solar Wind / Geomagnetic Activity:** CME influence from the arrival late on 16 Sep has now largely waned. No other CMEs feature in the current forecast.
Solar wind speeds are currently Slightly Elevated. A small small positive coronal hole may provide some enhancement later Day 1 and during Day 2 (18-19 Sep), perhaps seeing speeds of 500 km/s. Later Day 2 and for the remainder of the forecast, speeds are expected to return to slow ambient levels.

Quiet to Unsettled (Kp 0-3) conditions expected for much of the period, however later Day 1 and into Day 2 there is a Chance of Active (Kp 4) intervals and a Slight Chance of a G1/Minor Geomagnetic storm interval resulting from the potential connection to a HSS.

**Energetic Particles / Solar Radiation:** High energy proton flux at GOES18 should continue to decline on Day 1 (18 Sep) and return to background levels. Slight chance of S1 later in the period takes into consideration the potential for enhancement from AR3824 and/or AR3825.
High energy electron flux should continue to show some suppression, but a rebound is anticipated later the period as levels recover following the CME influence with diurnal peaks at High. Increasing Chance of reaching the Active fluence threshold Days 3-4 (20-21 Sep). CH70/+ not felt likely to be impactful.

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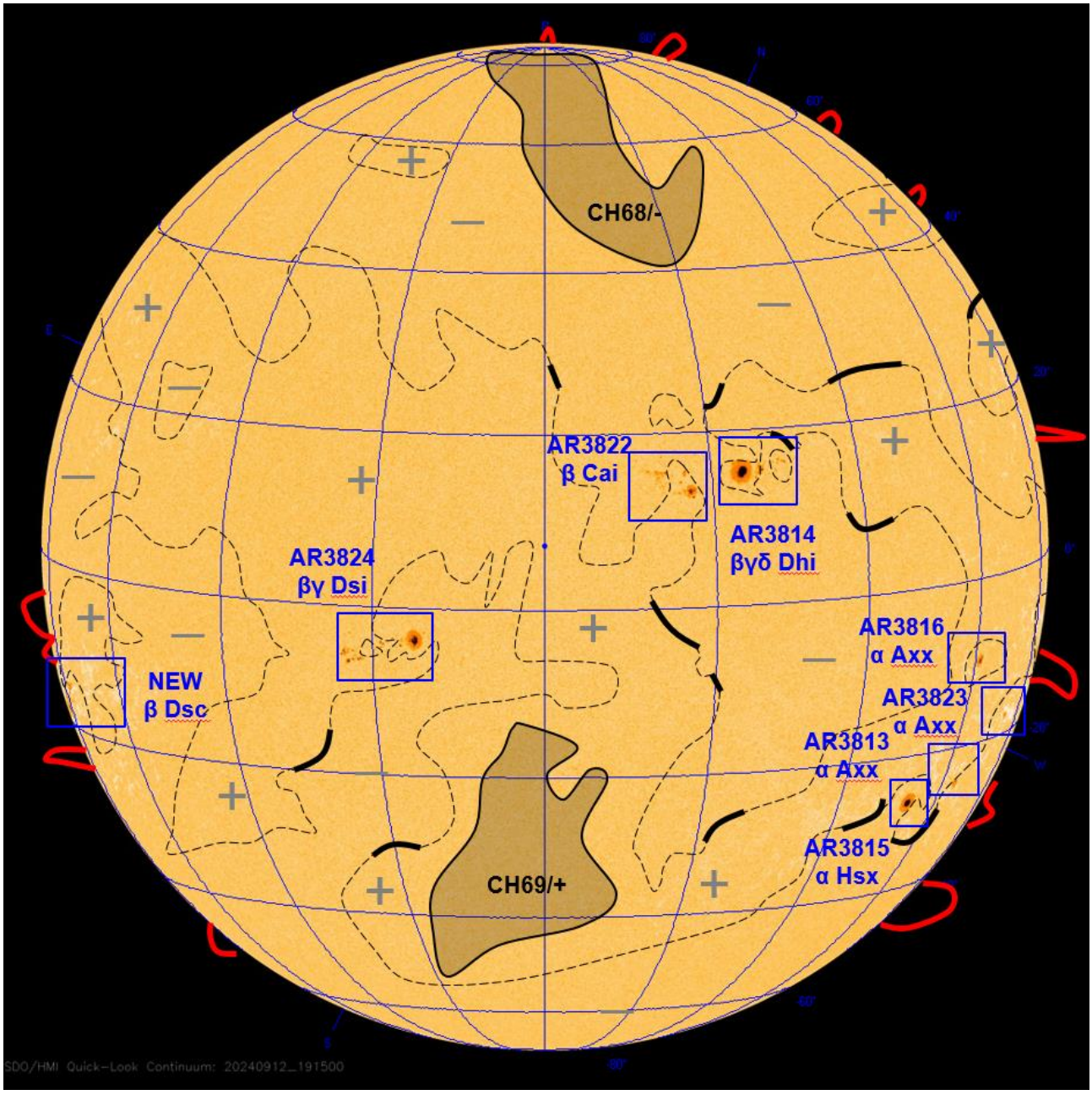
**Figure 1. Solar Analysis Valid 18/0800 UTC.**

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**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

Influence from the CME arrival late on 16 Sep continues to wane, with activity falling to generally Quet (Kp 1-2) levels during the first half of Day 1. No other CMEs feature in the current forecast. Solar wind speeds were initially at Elevated to Strong levels following CME enhancement, but are now around 420-450km/s having eased as CME influence waned. A small small positive coronal hole in the western disc (CH70/+) may provide some enhancement to the solar wind speeds at Earth for a time later Day 1 and into Day 2 (18-19 Sep), perhaps seeing speeds return to 500 km/s briefly. Later Day 2 and for the remainder of the forecast, speeds are expected to return to slow ambient levels.

Quiet to Unsettled (Kp 0-3) conditions expected for much of the period, however later Day 1 and into Day 2 there is a Chance of Active (Kp 4) intervals and a Slight Chance of a G1/Minor Geomagnetic storm interval resulting from the potential connection to a HSS.

| Geo-Magnetic Storm | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Minor or Moderate | G1 to G2 | Yes | 10 | 10 | 1 | 1 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

No CMEs feature in the current forecast.

**Figure 2: MOSWOC Enlil. Speeds are currently slightly above forecast levels.**

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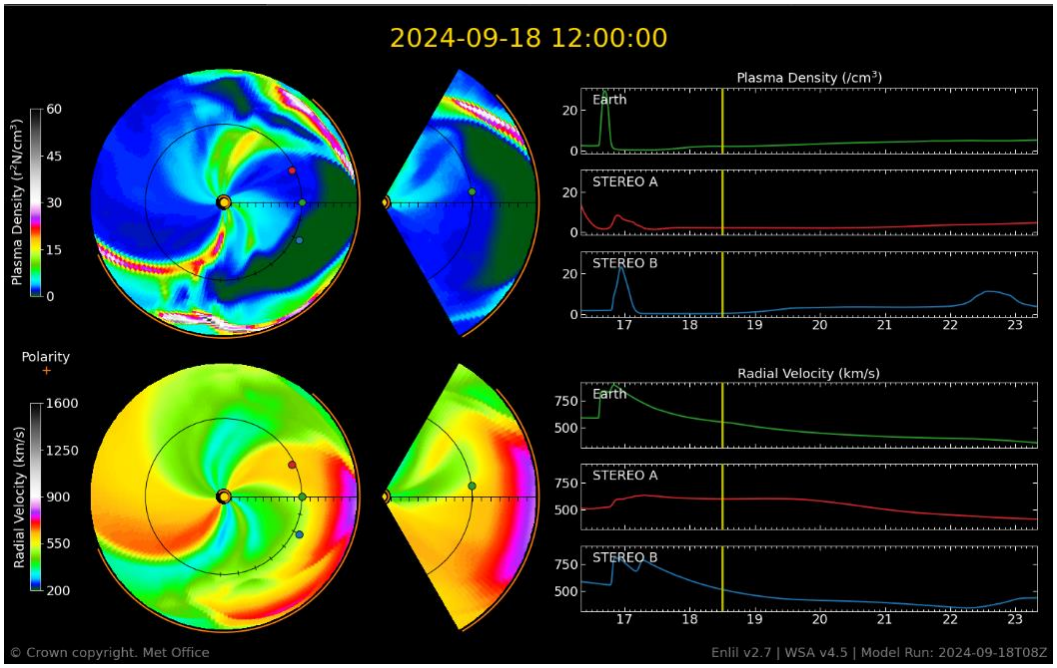


**Radio Blackouts - X-Ray Flares:**

There are approximately seven sunspot regions currently on the visible disc. AR3825 (Esi/Beta-Gamma-Delta), in the southeast, remains the largest and most complex region on the disc, although no significant growth has been observed in recent hours. This region consists of a large trailing spot, weak intermediate spots and a compact and complex lead portion which contains a marginal delta configuration. AR3825 remains perhaps the most noteworthy group due to its history of X-class activity. AR3824 (Eai/Beta-Gamma), in the southwest, is the other significant region of interest. This region is becoming increasingly difficult to analyse due to the viewing angle. AR3829 (Bxo), in the northwest, has decayed somewhat since being numbered. A number of spots rapidly emerged just to the north of AR3827 in the southeast; they are being noted as a NEW group but classification may change on subsequent analyses. Similarly, a number of spots have developed from plage or split from the large main spot of AR3828, also in the southeast. This had led to an increase in complexity in the region from a Hhx to Chi. The remaining regions are relatively small and stable.

Both of the dominant regions remain on the disc for the majority of the forecast, with AR3824 passing beyond the western limb during Days 3-4 (20-21 Sep). No significant regions are expected over the eastern solar horizon in the same interval, although SDO imagery and helioseismological mapping would suggest that some smaller regions may rotate across the eastern limb during the forecast period. The daily risk of flares is therefore held constant throughout in the absence of significant changes.

Overall, the chance of M-class flares is maintained with a slight chance of X-class flares. The X-class level is above raw probabilities due to the history of X-class activity from AR3825.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|

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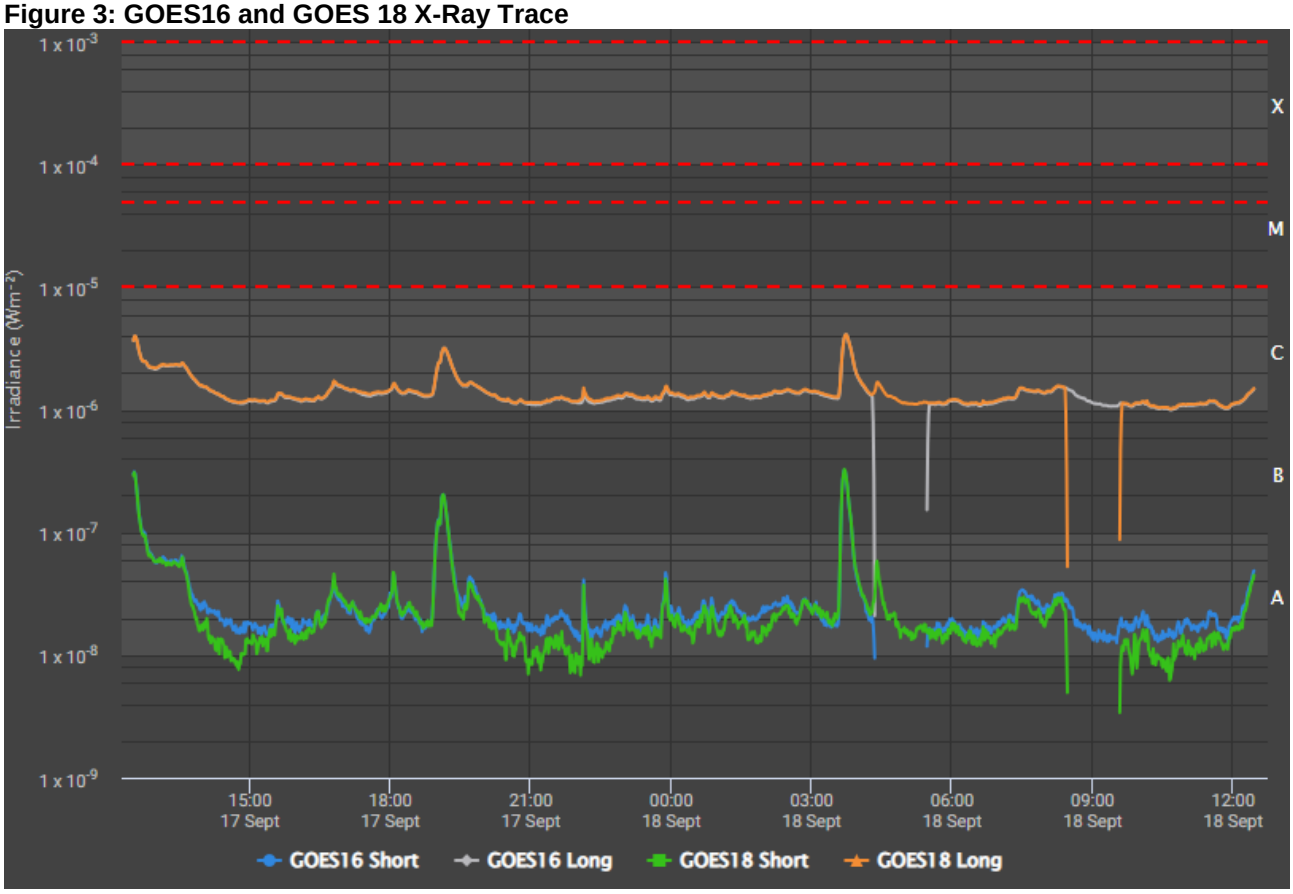
| Probability | | | (%) | (%) | (%) | (%) |
|---|---|---|---|---|---|---|
| Active | R1-R2 M Class | No | 40 | 40 | 40 | 40 |
| Very Active | R3 to R5 X Class | No | 10 | 10 | 10 | 10 |

**Figure 3: GOES16 and GOES 18 X-Ray Trace**

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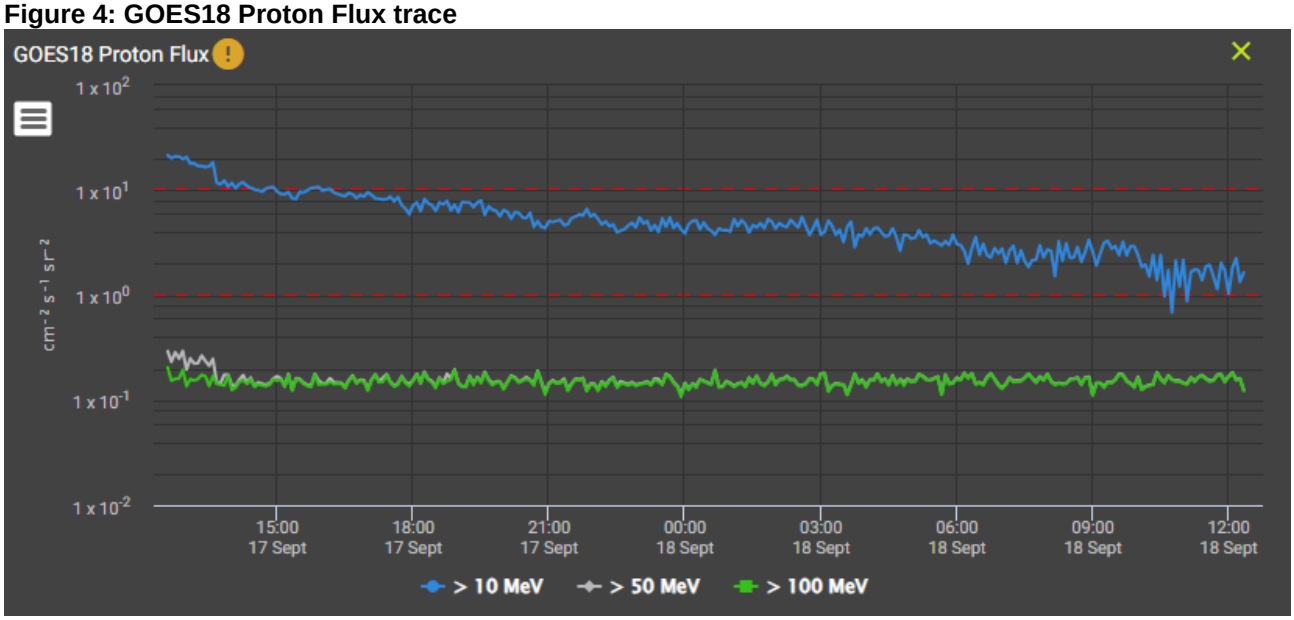
**Solar Radiation Storms - (High Energy Protons):**
High energy proton flux at GOES18 reached the S1/Minor Radiation Storm level during the 17 Sep but declined below the threshold around 17/1615L and has continued on a declining trend. There is a chance of new enhancements during the forecast period, this would be more likely from AR3824 given its more favourable position in the western solar hemisphere. AR3825, in the southeast, may also act as a source in the event of any significant activity, having previously produced a proton response.

High energy proton flux levels are expected to continue to wane Day 1 (18 Sep) and return to background. The slight chance of S1 later in the period takes into consideration the potential for enhancement from AR3824 and/or AR3825.

| Radiation Storms<br>Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | Yes | 20 | 10 | 10 | 10 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

**Figure 4: GOES18 Proton Flux trace**

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## High Energy Electrons Event (≥ 2MeV):

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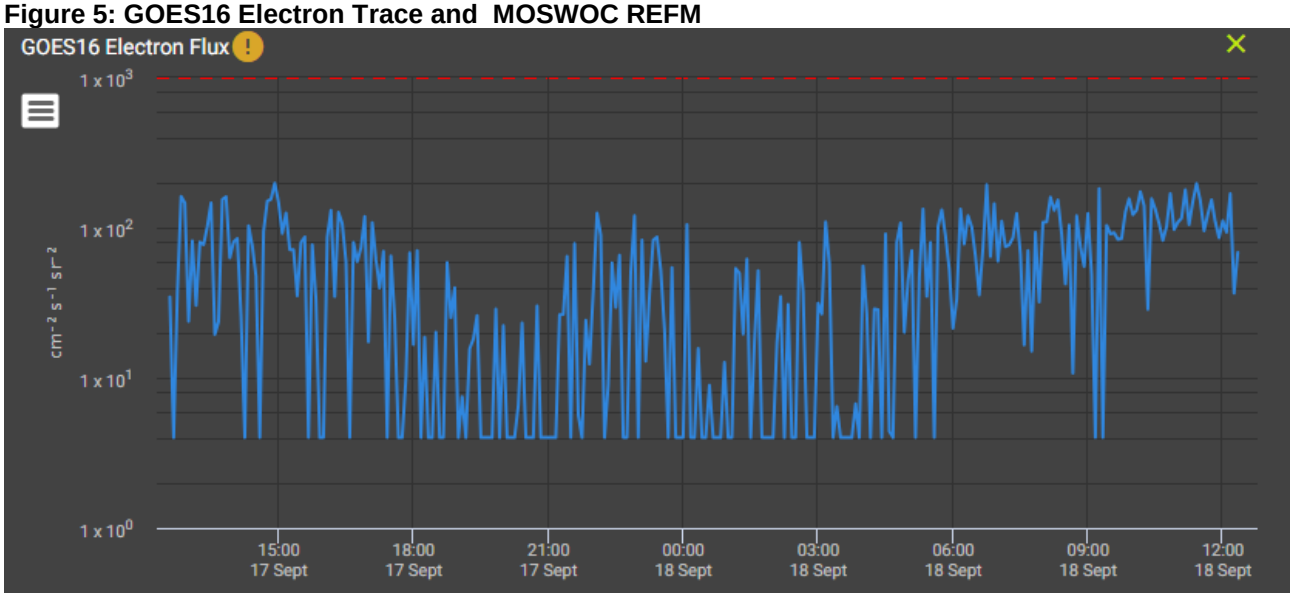
The forecast is therefore uncertain, but should continue to exhibit a suppression and then rise to an elevated level. The associated fluence is anticipated to rise uncertainly towards the Active threshold. MOSWOC REFM is not considered to be useful guidance given the dominance of recent CME influences.

| GEO Electron Environment | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ 2 MeV ≥ $1x10^8$ | No | 1 | 10 | 30 | 30 |
| Very Active | ≥ 2 MeV ≥ $1x10^9$ | No | 1 | 1 | 1 | 1 |

**Figure 5: GOES16 Electron Trace and MOSWOC REFM**

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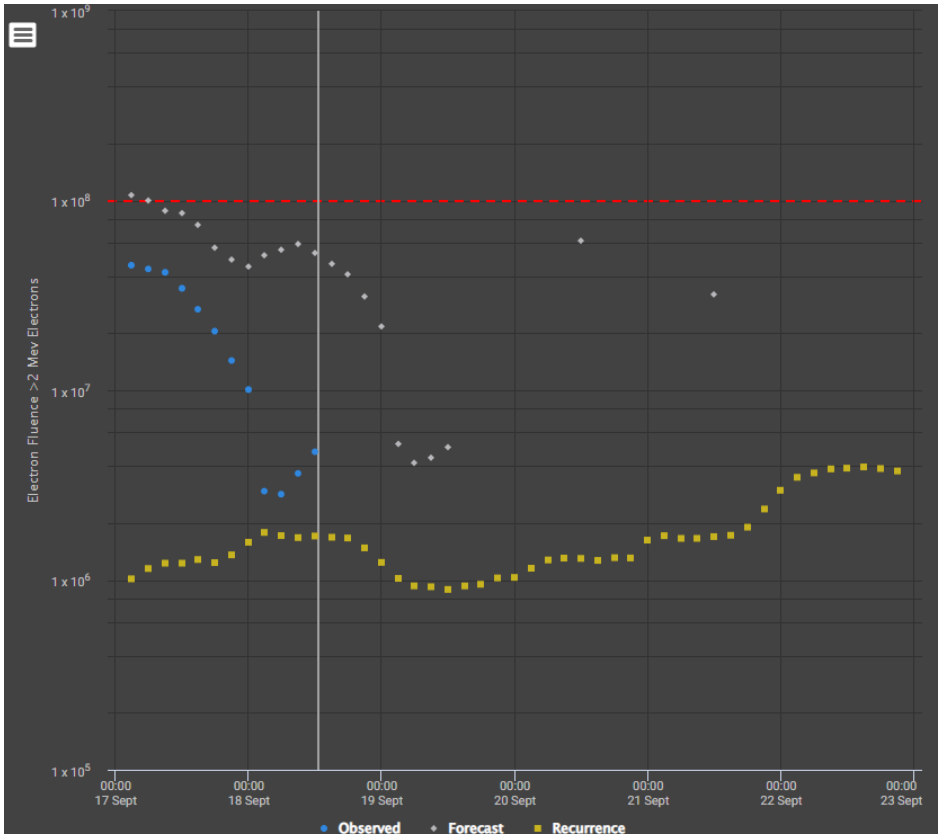


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